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The following specifications are drawn from the documents submitted by the applicant

Examination request pursuant to § 44 Pat.Law is presented

Apparatus for displaying signs and symbols

Apparatus for displaying signs and symbols by means of a plurality of luminous elements arranged in matrix-form in rows and columns on a screen and excitable for light emission through the frontal directional lobe in various monochromatic tones, whereby [the light emission] combines the luminous elements and n various monochromatic tones into one geometrical [pixel]. The pixels are arranged such that excitation of the luminous elements within each column or [row] results in a respective fluctuation while the luminous elements in adjacent columns or rows are darkened, being characterized by a multiplex system of luminous elements within such a pixel resulting in m multiplex phases,
and in each multiplex phase at least one luminous element within each pixel is excitable, and in each multiplex cycle each luminous element within a pixel is excitable at least once.
An enhanced image quality is produced by this multiplex procedure, along with simultaneous minimization of the component and interconnection costs.

[On the upper diagram, the y-axis is for "brightness," while the x-axis is for "time," and the lower diagram has "pixel" as the y-axis label. The colors denoted in the upper diagram are, from left to right and top to bottom, "red," "blue," "green / 2," "green / 2," "red," "blue," "green / 2," "green / 2." These are also the same labels as utilized in the affixed original diagrams]

Description

The invention comprises an apparatus for displaying signs and symbols with luminous elements according to the superordinate concept of claim 1 or 2.

Such apparatuses are known, for example through the German patent publication 35 13 607 A1.

These display apparatuses containing, for example, incandescent lamps or light-emitting diodes as light or luminous elements are utilized more as informational screens, for example for traffic instruction, airplanes, stadium, arena or hall screens and the like.

The individual image points in such display systems are realized through a pixel stemming from, as a rule, 4 or 5 different color-emitting luminous elements. The prior art [describes a person] utilizing luminous elements emitting red, green and blue light, together producing a white light according to the Goethe color theory. By application of light-emitting diodes as luminous elements, the four or five luminous element [containing] pixels stemming from two red, one to two green and one blue light-emitting diode elements dominate.

In display apparatuses with relatively coarse screen[s] the luminous elements are mostly triggered separately. Higher resolution and smaller screen[s] therewith allow pixels triggered in a multiplex system. That is, the odd and even pixel columns are triggered or darkened alternately so that at any one time only every other column of the display apparatus shows the correspondingly displayed image, while the other respective pixel columns are darkened.

Even the micro mirror principle has become known in the smallest color screens with an order of magnitude of centimeters, wherein the color screen stems from a chip that contains a large sum of electronically triggered mini-mirrors which either reflect or do not reflect the external light that enters. The external light that enters may produce color or black and white images through a sort of Nipkow scanning-disc with red, green and blue permittivity of the spinning discs distributed in sectors.

The disadvantage of multiplexed display apparatuses in the prior art is that there is a great variation in brightness that is clearly perceived by the human eye and quite noticeable. Multiplexing of individual pixel columns makes the image appear streaky to the onlooker; this effect is particularly stark when the onlooker moves or glances across the display.

The task of the present invention was therefore to provide an apparatus of the aforementioned type which [would] avoid great variations in brightness through multiplexing and thereby allow a better image quality.

This task was resolved with the denoted characteristics of claim 1 or 2.

Advantageous embodiments are given by the subordinate claims.

The advantages of display apparatuses according to the invention pertain to a fundamentally enhanced image quality insofar as streakiness or the streaky effect is eliminated. A further advantage is that the component cost[s] for the multiplex procedure are not increased but rather decreased through three or more phase multiplexing. The invention makes use of the knowledge that the human eye is much less sensitive to chromatic fluctuations than it is to fluctuations in brightness, whereby the chromatic multiplexing according to the invention cannot be perceived by the onlooker. Apart from savings on components, chromatic multiplexing according to the invention also achieves a reduction of the internal interconnections in the display.

The description of the invention and figures now follows.

Fig. 1 shows a time graph of the multiplex system and the light-emitting diode triggering of a four luminous element [containing] pixel according to claim 5.

Fig. 2 is the plot of a time graph with chromatic multiplexing that is described in claim 8 and is based on triggering pixels with five light-emitting diodes.

At the bottom of **Fig.** 1 is the plot of triggering such a pixel, based on two red, one green and one blue light-emitting diode, over two periods T of the multiplex time [scale], and this is recognizable through light emissions. In the upper portion of **Fig.** 1 the brightness is plotted corresponding to the multiplex time [scale] from the [lower graph]. In the first phase both red-light light emitting diodes are triggered, leading to a brightness of 30%. In the second phase of the multiplex time [scale] of the multiplex period a green diode is triggered, delivering ca. 60% of the brightness. Finally the blue diode is triggered in the third phase of the multiplex time [scale]; it delivers 10% of the brightness. This [process] repeats itself in the subsequent periods of the multiplex time [scale]. On the basis of combining the singular emissions of the red, green and blue light-emitting diodes in a multiplex period results in 100% white [light]. Indeed, the brightness of a white image during such a multiplex period decreases by between 10 and 60%, which is of course not optimal, but optically it appears distinctly superior to multiplexing pixel columns according to the prior art, where there is a volumetric brightness loss of 100%.

At the bottom of **Fig.** 2 are pixels with five LED's being triggered over the multiplex time [scale] of two periods T. In the first multiplex phase both red LED's are triggered, leading to a brightness of 30% (see above). In the second multiplex phase one of the green LED's is half-excited, producing nevertheless ca. 30%

of the brightness, and simultaneously a blue light-emitting diode is excited producing, with its [additional] 10% [brightness], a total brightness of 40% in this phase. In the third phase the other green LED is excited with a half current, producing however some 30% of the brightness. A further improvement to the brightness difference results therewith, [now equal] to only 10%. A further halving of the brightness differences is achieved, for example, if one excites the green light-emitting diode in the second phase with only 25% and the other green diode in the third phase with 35% brightness current. Thereby the brightness over two multiplex phases is constant and drops off by around 5% only in the third phase.

Patent Claims

1. Apparatus for displaying signs and symbols by means of a plurality of luminous elements arranged in matrix-form in rows and columns on a screen and excitable through the frontal directional lobe in various monochromatic tones, whereby [the light emission] combines the luminous elements and various monochromatic tones into one geometrical [pixel]. The pixels are arranged such that excitation of the luminous elements within each column or row results in a respective fluctuation while the luminous elements in adjacent columns or rows are darkened, **being characterized by** a multiplex system of luminous elements within such a pixel, and in each multiplex phase at least one luminous element of each pixel is excitable, and there are excitable: the luminous element of a first chromatic tone in the first multiplex phase, the luminous element of a second monochromatic tone in the second multiplex phase and the luminous element of an nth monochromatic tone in the nth multiplex phase.

2. Apparatus for displaying signs and symbols by means of a plurality of luminous elements arranged in matrix-form in rows and columns on a screen and excitable through the frontal directional lobe in various monochromatic tones whereby [the light emission] combines the luminous elements and various monochromatic tones into one geometrical [pixel]. The pixels are arranged such that excitation of the luminous elements within each column or row results in a respective fluctuation while the luminous elements in adjacent columns or rows are darkened, being characterized by a multiplex system of luminous elements within such a pixel resulting in m multiplex phases, and in each multiplex phase at least one luminous element of each pixel is excitable and in each multiplex cycle each luminous element within a pixel is excitable at least once.

3. Apparatus according to claim 1 or 2, being characterized by utilizing light-emitting diodes.

4. Apparatus according to one of the foregoing claims, being characterized by utilizing the primary colors red, green and blue as monochromatic tones.

5. Apparatus according to claims 1, 3 and 4, being characterized by n = 3 multiplex phases, and there are excitable: two red-light light-emitting diodes in the first multiplex phase, a green-light light-emitting diode in the second multiplex phase and a blue-light light-emitting diode in the third multiplex phase (**Fig.** 1).

6. Apparatus according to claims 2, 3 and 4, being characterized by at least two simultaneously excitable luminous elements of the same or different monochromatic tone(s) in at least one of the m multiplex phases.

7. Apparatus according to claim 6, being characterized by luminous elements excitable by various current strengths.

8. Apparatus according to claim 7, being characterized by m = n = 3 multiplex phases, and there are excitable: two red-light light-emitting diodes in the first multiplex phase, one green-light light-emitting diode halfway to the green brightness [level] required for white [light] and a blue-light light-emitting diode in the second multiplex phase and one green-light light-emitting diode halfway to the green brightness [level] required for white [light] in the third multiplex phase.

9. Apparatus according to claim 7, being characterized by such luminous elements excitable so that the aforementioned brightness variations are minimized through multiplexing.

Hereto 2 pages of diagrams

CERTIFICATION OF TRANSLATION

The undersigned, Mark Cella Trousdale, whose address is 1055 Oakland Ave., Menlo Park, CA 94025-2205 U.S.A., declares and states as follows:

I am well acquainted with the English and German languages; I have in the past translated numerous German documents of legal and/or technical content into English.

I have been requested to translate a German document identified as **German Patent Publication No. DE 199 23 527 A1 filed on May 21, 1999, and entitled "APPARATUS FOR DISPLAYING SIGNS AND SYMBOLS."**

To a copy of this German document I therefore attach the English translation and my Certification of Translation.

I hereby certify that the English translation of the above cited German document identified as **German Patent Publication No. DE 199 23 527 A1 filed on May 21, 1999, and entitled "APPARATUS FOR DISPLAYING SIGNS AND SYMBOLS"** is, to the best of my knowledge and ability, an accurate translation.

And I declare further that all statements made herein of my own knowledge are true, that all statements made on information and belief are believed to be true, and that these statements and the like are punishable by fine and imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

May 29, 2003

Date

Mark Cella Trousdale